



Stability of natural bacteriogenic iron oxides (BIOS) and their role in Sr cycling.

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Bacteriogenic iron oxides (BIOS), composed of a mixture of poorly ordered hydrous ferric oxides and intact and partially decomposed bacterial cells, are thought to play an important role in regulating aqueous trace element concentrations in groundwater-supplied wetland environments. We have initiated a study examining the seasonal variation in the biogeochemistry of BIOS and its role in contaminant sequestration in a wetland site at Chalk River, Ontario, Canada, an area that hosts an exceptional abundance of BIOS. We have also carried out Sr sorption experiments with fresh and aged BIOS in order to assess the long-term stability of the Sr-bacteria-iron oxide composite under reducing conditions. SEM observations of representative BIOS samples found a predominance of a sheathed bacterium resembling *Leptothrix ochracea*, an Fe(II)-oxidizing organism known to thrive under circumneutral pH, high dissolved Fe(II) and low dissolved oxygen concentrations. The BIOS mineralogy was dominated by 2-line ferrihydrite, although some samples collected further downstream from the groundwater discharge zone appear more closely related to 6-line ferrihydrite. Iron reduction was noted at depth in both the sedimentary and porewater profiles, with the dissolved Fe(II) peak in the latter occurring at shallower depths in summer compared to the spring. Strontium, a contaminant of concern at this site, showed little seasonal variation, but its concentration was broadly correlated with that of dissolved iron and manganese. In addition, porewater strontium concentrations were 2-3 fold higher at a nearby control site where BIOS was absent, indicating the likely importance of

BIOS in attenuating migration of this contaminant. On the other hand, reduction experiments showed that BIOS was easily reduced by *Shewanella putrefaciens* CN32, a common iron-reducing bacterium. Calculated reduction rates for BIOS were significantly higher than those reported for synthetic ferrihydrite. During the reduction experiments, Sr release mirrored that of Fe(II) release into solution, suggesting that it was likely sorbed onto the iron oxides and not the bacterial surface.